IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of: Alexandros T. Demos et al.		Confirmation No.	7358
Serial No.:	10/783,748	Examiner:	Khiem D. Nguyen
		Art Unit:	2823
Filed:	February 20, 2004	Atty. Docket No.	017499-0360962 AMAT-7034
For:	Clean Process for an Electron Beam Source		

Submitted electronically.

BRIEF ON APPEAL

Mail Stop APPEAL
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

This paper is further to the Notice of Appeal filed February 15, 2007. A supportive brief is originally due April 15, 2007 and is currently due May 15, 2007. The Commissioner is authorized to charge the large entity fee for filing a brief in support of an appeal in the amount of $500.00, and any required fee to Pillsbury Winthrop Shaw Pittman LLP's deposit account no. 50-2213 (order no. 017499-0360962).

Petition for Extension of Time. Appellants respectfully petition for an extension of time under Rule 136(a) of one month to cover the filing date of this paper. The Commissioner is authorized to charge the large entity fee for a one-month extension in the amount of $120.00, and any required fee to Pillsbury Winthrop Shaw Pittman LLP's deposit account no. 50-2213 (order no. 017499-0360962).

REAL PARTY IN INTEREST

The real party in interest is Applied Materials, Inc., which has full title to the present application by virtue of an assignment from the inventors recorded at Reel/Frame No. 015012/0844.

RELATED APPEALS AND INTERFERENCES

There are no appeals or interferences that will directly affect, be directly affected by, or have a bearing on the Board's decision in this appeal.

STATUS OF CLAIMS

Claims 1 and 4-23 are pending in the application, all of which stand finally rejected. The rejections of all pending claims 1 and 4-23 are appealed.

STATUS OF AMENDMENTS

In response to the Final Office Action mailed September 15, 2006, Appellants filed an Amendment on December 15, 2006. According to the Advisory Action mailed January 16, 2007, this amendment was entered. No further amendments have been filed and/or not entered.

SUMMARY OF CLAIMED SUBJECT MATTER

The present invention relates to electron beam treatment for fabricating integrated circuit devices, and more particularly provides a method and apparatus for cleaning an electron beam (e-beam) treatment apparatus.

In accordance with certain aspects, during e-beam treatment of low-k dielectric CVD deposited films and the like, various organic and/or organo-silicon-based species may be volatilized and out-gassed from the e-beam treated films. At least some of these out-gassed species may deposit on the walls of an e-beam treatment chamber, and coat an electron beam source region. Over time, failing to clean such residue from an e-beam treatment apparatus may produce poor process performance. (see the present specification at, for example, paragraph [0007]).

The present invention provides a method and apparatus for effectively cleaning residues such as this in an e-beam treatment apparatus. In accordance with certain aspects, the cleaning process entails the use of the e-beam source to generate an electron beam, that in turn, energizes a cleaning gas in the e-beam chamber. The present inventors have discovered that the value of electron beam current is an important factor in determining how quickly the chamber is cleaned along with the introduction of the cleaning gas. Accordingly, a pressure of the cleaning gas is varied to maintain the electron beam current at a substantially constant value. (see the present specification at, for example, paragraphs [0032]-[0033]).

According to further aspects, the inventors have discovered that reaching and maintaining a relatively constant value of a chamber pressure for a predetermined length of time indicates a process endpoint such as that the chamber has been sufficiently cleaned. Accordingly, at this point, the flow of gas may be stopped. (see the present specification at, for example, paragraph [0033]).

According to the above aspects of the invention, each independent claim (claims 1, 8 and 16) of the present application specifically requires a method of cleaning a chamber (e.g. chamber 120) of an electron beam treatment apparatus (e.g. apparatus 100 in FIG. 1) comprising the steps of generating an electron beam current through a cleaning gas (e.g. from source 107) to energize the cleaning gas in the chamber, adjusting a pressure of the cleaning gas to maintain the electron beam current at a substantially constant value, and stopping the flow of cleaning gas when the cleaning gas pressure becomes substantially constant for a predetermined length of time. (see FIG. 3, paragraphs [0032]-[0033], for example).

In some alternative embodiments, a high pressure chamber clean process uses a gas pressure of about 1 Torr or more. Accordingly, claims 13-15 require maintaining a gas pressure of about 1 Torr or more in the chamber (see the present specification at, for example, paragraph [0035]).

GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL

Claims 1, 4, 5, 8-10 and 13-15 have been finally rejected under 35 U.S.C. § 102(b) as being anticipated by U.S. Patent 5,981,960 to Ooaeh et al. ("Ooaeh"). Claims 16-18 and 21-23 have been finally rejected under 35 U.S.C. § 103(a) as being unpatentable over Ooaeh. The remaining pending claims 6, 7, 11, 12, 19 and 20 have been finally rejected under 35 U.S.C. § 103(a) as being unpatentable over Ooaeh in view of U.S. Patent No. 5,539,211 to Ohtoshi et al. ("Ohtoshi"). Appellants respectfully submit that these rejections are in error for multiple reasons, and seek review of the following independently reversible grounds:

- Whether the cited prior art discloses or suggests a cleaning method for an e-beam treatment apparatus with the following steps clearly required by each of the independent claims claim 1, 8 and 16:
    - adjusting a pressure of the cleaning gas to maintain the electron beam current at a substantially constant value, and
    - stopping the flow of cleaning gas when the cleaning gas pressure becomes substantially constant for a predetermined period length of time.
- Whether Ooaeh discloses or suggests a cleaning method for an e-beam treatment apparatus wherein a pressure of the cleaning gas of about 1 Torr or greater is maintained in the chamber, as required by claims 13-15.

ARGUMENT

The present claims patentably define over Ooaeh and Ohtoshi because neither Ooaeh nor Ohtoshi, alone or in combination, contain each and every limitation of the claims.

The § 102 rejection of claims 1, 4, 5, 8-10 and 13-15 based on Ooaeh should be reversed. A cited prior art reference anticipates a claimed invention under 35 U.S.C. §102 only if every element of the claimed invention is identically shown in the single reference, arranged as they are in the claims. MPEP §2131; *In re Bond*, 910 F.2d 831, 832, 15 USPQ 2d 1566, 1567 (Fed. Cir. 1990). Each and every limitation of the claimed invention is significant and must be found in the single cited prior art reference. *In re Donohue*, 766 F.2d 531, 534, 226 USPQ 619, 621

(Fed. Cir. 1985). Where limitations are not explicitly present, "[t]o establish inherency, the extrinsic evidence 'must make clear that the missing descriptive matter is necessarily present in the thing described in the reference, and that it would be so recognized by persons of ordinary skill. Inherency, however, may not be established by probabilities or possibilities. The mere fact that a certain thing may result from a given set of circumstances is not sufficient.'" *In re Robertson*, 169 F.3d 743, 745, 49 USPQ2d 1949, 1950-51 (Fed. Cir. 1999) (citations omitted).

The § 103 rejectionsof claims 16-18 and 21-23 based on Ooaeh and claims 6, 7, 11, 12, 19 and 20 based on Ooaeh and Ohtoshi should be reversed. A *prima facie* case of obviousness under § 103 requires that each and every limitation be taught or suggested in the cited prior art. MPEP 2143.03; *In re Royka*, 490 F.2d 981 (CCPA 1974).

The Cited Prior Art Does Not Disclose Or Suggest The Cleaning Method Required By Independent Claims 1, 8 and 16

Independent claims 1 and 8 have been finally rejected under § 102 as being anticipated by Ooaeh and independent claim 16 has been finally rejected under § 103 as being unpatentable in view of Ooaeh. These rejections should be reversed because Ooaeh does not disclose or suggest each and every limitation of the independent claims, and Ooaeh's deficiencies would not have been cured by the alleged combination of Ooaeh and Ohtoshi. Accordingly, the rejections of all the pending claims should be reversed for at least this reason.

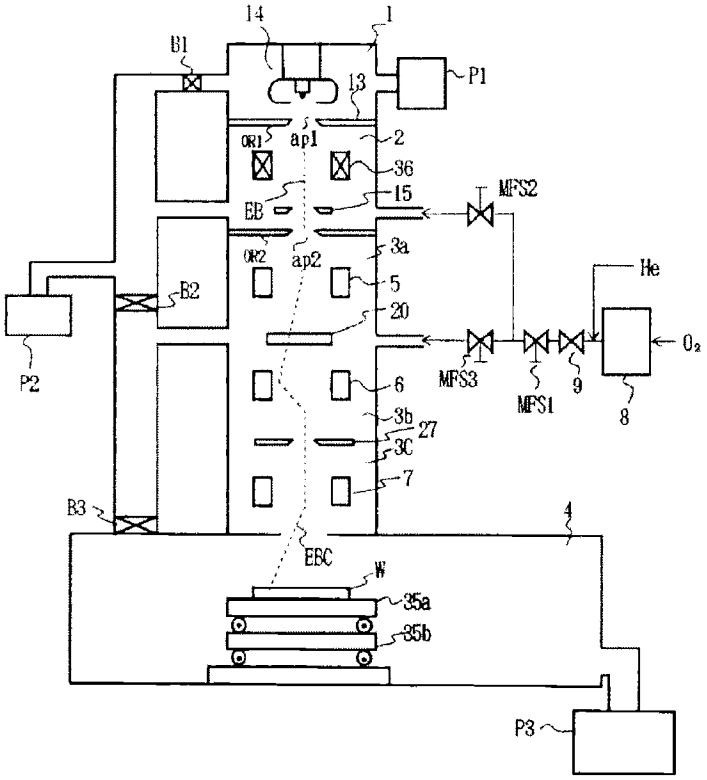
A. Ooaeh Does Not Explicitly or Inherently Disclose Or Suggest Adjusting A Pressure Of The Cleaning Gas To Maintain The Electron Beam Current At A Substantially Constant Value As Required By Independent Claims 1, 8 and 16

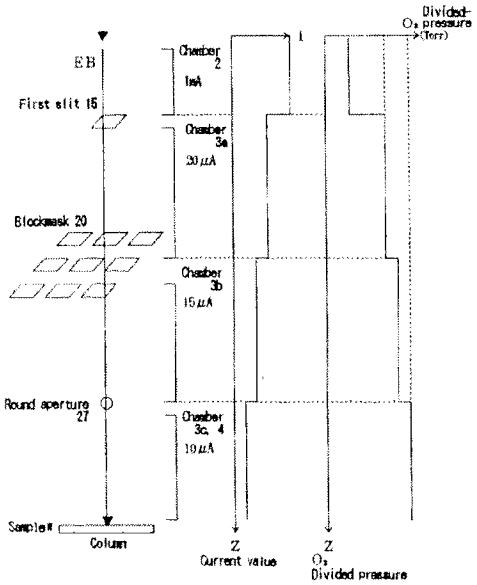
Independent claims 1, 8 and 16 define a cleaning method for an electron beam treatment apparatus that comprises, *inter alia*, "adjusting a pressure of the cleaning gas to maintain the electron beam current at a substantially constant value." In the Final Office Action, the Examiner took the position that Ooaeh teaches this limitation (Detailed Action at 6), and in response to the Final Office Action, Appellants disputed this position.

In remarks accompanying the Advisory Action, the Examiner explained that:

Applicants' attention is respectfully directed to (col. 7, line 10 to col. 8, line 53 and FIGS. 6 and 8) where Ooaeh discloses adjusting a pressure of the cleaning gas in the main chamber 4 to 5x10-6 – 2x10-5 Torr (col. 7, lines 10-20), and in FIG. 8 Ooaeh shows that the electron beam current in each individual chamber 2, 3a, 3b, 3c, and 4 is maintained at a substantially constant value. Thus, Ooaeh does teach adjusting a pressure of the cleaning gas to maintain the electron beam current at a substantially constant value.

For convenience, FIGs. 1 and 8 of Ooaeh are reproduced below.





As set forth in Appellants previous response, Ooaeh does not adjust a cleaning gas pressure to maintain a substantially constant electron beam current value. Rather, Ooaeh merely sets a pressure in response to the value of an independently-controlled electron beam. There is no teaching that Ooaeh aims at keeping the current constant, nor that the cleaning gas is adjusted so as to do that, as explicitly required the independent claims. Ooaeh merely teaches that, with reference to FIG. 8 (col. 10, lines 28-44):

> The current of an electron beam in the individual areas is reduced as the electron beam passes through the corresponding slits or mask, and an example current strength for the electron beam in each area is shown in FIG. 8. As is apparent from FIG. 8, the concentration of ozone (divided pressure) is increased as the strength of the current is reduced. In other words, the concentration of ozone is reduced in an area in which the current of the electron beam is high, and the concentration of ozone is increased in an area in which the current of an electron beam is low.

In other words, Ooaeh teaches that whatever the current happens to be in a given chamber, the pressure is set in inverse proportion thereto. Where the current is high, the ozone pressure is set low, and vice-versa.

This teaching is not enough to meet the explicit limitations of the independent claims which require that the cleaning gas pressure is adjusted to maintain the electron beam current to a substantially constant value.

Although the Office Action does not provide any theory of rejection based on inherency, such a theory would be wrong. To support a rejection based on inherency, the Examiner "must provide a basis in fact and/or technical reasoning to reasonably support the determination that the allegedly inherent characteristic necessarily flows from the teachings of the applied prior art." *Ex parte Levy*, 17 USPQ2d 1461, 1464 (Bd. Pat. App. & Inter. 1990) (emphasis in original). Moreover, the Examiner's evidence and reasoning "'must make clear that the missing descriptive matter is necessarily present in the thing described in the reference, and that it would be so recognized by persons of ordinary skill. . . . The mere fact that a certain thing may result from a given set of circumstances is not sufficient.'" *In re Robertson*, 169 F.3d 743, 745, 49 USPQ2d 1949, 1950-51 (Fed. Cir. 1999) (emphasis added).

One skilled in the art would not consider that a method for adjusting a cleaning gas pressure to maintain a substantially constant value of an electron beam current would necessarily flow from Ooaeh's teachings. Rather, a more likely scenario is that Ooaeh's pressure is adjusted in response to changes in the electron beam current, and that other independent devices and controls are used to adjust the electron beam current. Accordingly, Ooaeh would not have inherently suggested the method of the present claims either.

For at least the foregoing reasons, Ooaeh does not explicitly or inherently disclose or suggest adjusting a cleaning gas pressure to maintain a substantially constant electron beam current. Accordingly, the § 102 rejection of independent claims 1 and 8 along with claims 4-5 that depend from claim 1 and claims 9-10 that depend from claim 8, should be reversed for at least this reason. Also, the § 103 rejection of independent claim 16 along with claims 17-18 and 23 that depend from claim 16, as well as the § 103 rejection of claims 21 and 22 that depend from claims 1 and 8 respectively, should be reversed for at least this reason.

B. Ooaeh Does Not Explicitly or Inherently Disclose Or Suggest Stopping The Flow Of Cleaning Gas When The Cleaning Gas Pressure Becomes Substantially Constant For A Predetermined Length Of Time As Required By Independent Claims 1, 8 and 16

Independent claims 1, 8 and 16 define a cleaning method that further comprises, *inter alia*, "stopping the flow of cleaning gas when the cleaning gas pressure becomes substantially constant for a predetermined length of time."[1] In the Final Office Action, the Examiner took the position that Ooaeh teaches this limitation (Detailed Action at 6), and cites only the following passage (col. 5, lines 8-19, emphasis added) for support:

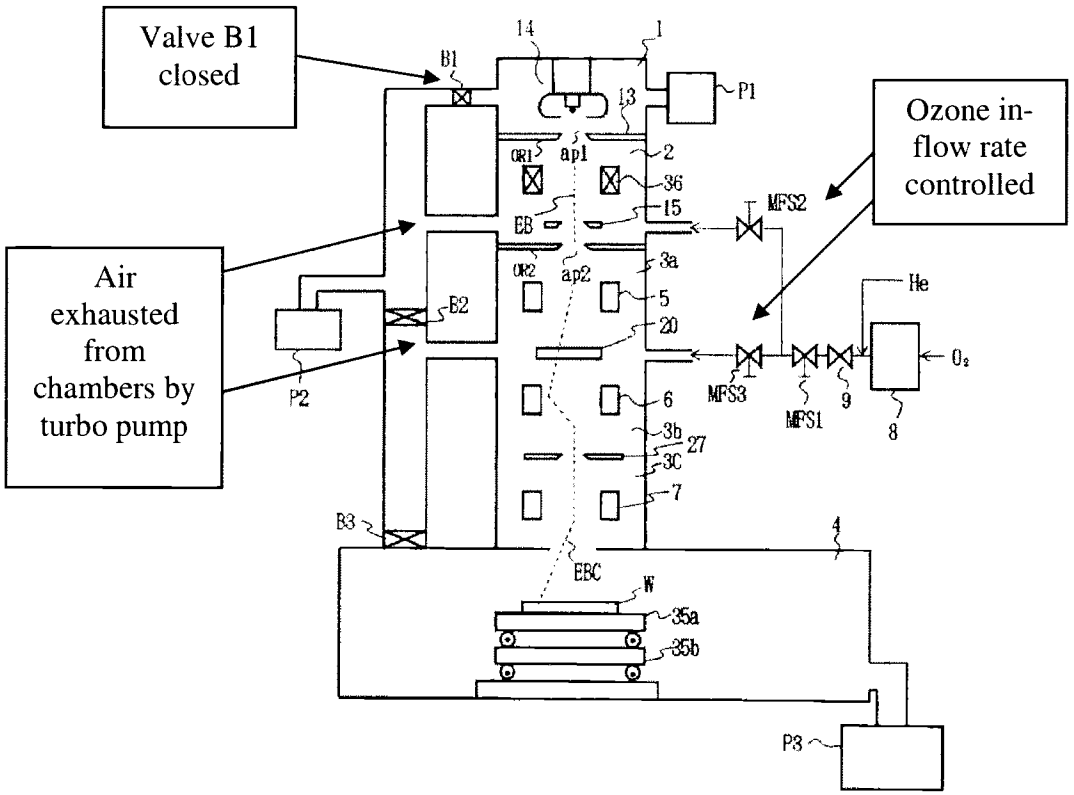
> In this embodiment, ozone is introduced into the chambers of the electron beam exposure apparatus. The introduced ozone is separated into oxygen and activated oxygen by collision with an electron beam. The activated oxygen reacts with the carbon contamination that has accumulated on or has been deposited on the surface of the components. The reacted gas thereby is diffused as carbon oxide gas or carbon dioxide gas so that the occurrence of a beam drift is prevented. An ozonizer 8 generates ozone, which is introduced into the chambers through a valve 9 that is freely opened and closed, and through mass flow sensors MFS 1, 2 and 3.

As should be clear from this passage, Ooaeh teaches nothing about stopping the flow of cleaning gas when the cleaning gas pressure becomes substantially constant for a predetermined

[1] The corresponding wording of independent claim 16 is "stopping the introduction of the cleaning gas when the cleaning gas pressure reaches a substantially constant value and maintains the value for a length of time of 5 seconds."

length of time. Rather, this passage of Ooaeh merely states that the ozone valve can be opened and closed.

Obviously valve 9 must close and the flow of ozone gas must stop at some point (e.g. when the device is not being used). However, there is absolutely no teaching or suggestion that Ooaeh stops the flow of the cleaning gas when its pressure becomes substantially constant for a predetermined length of time, as explicitly required the independent claims. On the contrary, Ooaeh teaches that, beginning at col. 4, line 60, all the chambers are evacuated to a high vacuum of 1x10-5 Torr. Then, at col. 5, line 61, valve B1 separating chamber 1 for the remaining chambers is closed, while the turbo pump P2 for exhausting the remaining chambers is operated. Then, at col. 6, line 1, ozone is supplied to chambers 2 and 3, and air "is exhausted from chambers 1 and 2 under different pressures." Meanwhile, at col. 6, line 23, the mass flow sensors MFS2 and MF3 are controlled to maintain different ozone gas pressures in chambers 2 and 3. FIG. 1 of Ooaeh is reproduced below for convenience.



Accordingly, if anything, Ooaeh teaches the opposite of the claimed invention. That is, because air is continually exhausted from the chambers, the flow of ozone must be continued so

as to maintain the desired ozone gas pressure in the chambers at a predetermined value. This further requires that valve 9 remains open (i.e. the flow of cleaning gas is never stopped in connection with maintaining a given gas pressure). Presumably, the only time valve 9 is closed and the flow of gas is stopped is when the device is not being used and/or when the process restarts and the chambers must be evacuated again. However, Ooaeh provides no teaching or suggestion that the flow is ever stopped "when the cleaning gas pressure becomes substantially constant for a predetermined length of time."

Although the Office Action does not provide any theory of rejection based on inherency, such a theory would be wrong. One skilled in the art would not consider that a method for stopping a flow of cleaning gas when the cleaning gas pressure becomes substantially constant for a predetermined length of time necessarily flows from Ooaeh's teachings. Rather, a more likely scenario is that Ooaeh's cleaning gas flow is constantly adjusted and kept flowing in response to changes in the electron beam current, and that other devices and controls are used to determine when to stop the flow of gas. Accordingly, Ooaeh would not have inherently suggested the method of the present claims either.

For at least the foregoing reasons, Ooaeh does not explicitly or inherently disclose or suggest stopping the flow of a cleaning when the gas pressure becomes substantially constant for a predetermined length of time. Accordingly, the § 102 rejection of independent claims 1 and 8 along with claims 4-5 that depend from claim 1 and claims 9-10 and 13-15 that depend from claim 8, should be reversed for at least this reason. Also, the § 103 rejection of independent claim 16 along with claims 17-18 and 23 that depend from claim 16, as well as the § 103 rejection of claims 21 and 22 that depend from claims 1 and 8 respectively, should be reversed for at least this reason.

C. The Alleged Combination Of Ooaeh With Ohtoshi Would Not Have Cured The Deficiencies Of Ooaeh With Respect To Independent Claims 1, 8 and 16

Claims 6 and 7 depend from claim 1, claim 12 depends from claim 8, and claims 19 and 20 depend from claim 16. These claims stand finally rejected as being unpatentable over Ooaeh in view of Ohtoshi.

However, as shown above, independent claims 1, 8 and 16 patentably define over Ooaeh. The alleged combination of Ohtoshi with Ooaeh would not have cured the deficiencies of Ooaeh with respect to the independent claims noted above. Accordingly, the alleged combination of Ooaeh and Ohtoshi would not have suggested the inventions of claims 6, 7, 12, 19 and 20 either.

Accordingly, the § 103 rejection of claims 6 and 7 that depend from claim 1, claim 12 that depends from claim 8, and claims 19 and 20 that depend from claim 16, should be reversed for at least this reason.

The Cited Prior Art Does Not Disclose Or Suggest The Cleaning Method Required By Dependent Claims 13, 14 and 15

Claims 13-15 have been finally rejected under § 102 as being anticipated by Ooaeh. These claims depend from independent claim 8 and the rejections should be reversed at least because Ooaeh does not disclose or suggest each and every limitation of independent claim 8 as shown above. However, the rejections of these claims should be reversed for at least one additional and independent reason.

More particularly, each of these claims require that a cleaning "gas pressure of about 1 Torr or greater is maintained in the chamber."

Ooaeh does not teach, and in fact teaches away from maintaining such cleaning gas pressures. As shown above, Ooaeh explicitly teaches at col. 6, lines 19-22 that "a higher vacuum is maintained in the upstream chamber [2], where the volume of the electron beam is greatest, and a lower vacuum is maintained in the downstream chamber [3]." In other words, Ooaeh teaches maintaining an extremely low (near vacuum) concentration of cleaning gas in the chambers. At the highest levels, Ooaeh teaches at col. 7, lines 12-18 maintaining a gas pressure of between $5x10^{-6}$ to $2x10^{-5}$ Torr, which is less than one ten-thousandths of the pressure required by the claims.

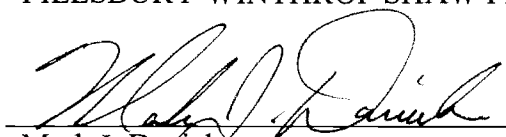
Accordingly, Ooaeh teaches away from the inventions of claims 13-15 and the § 102 rejections thereof based on Ooaeh should be reversed for at least this additional reason.

CONCLUSION

For the foregoing reasons, Appellants respectfully request that all the pending claims be deemed allowable by this honorable Board.

Respectfully submitted,
PILLSBURY WINTHROP SHAW PITTMAN LLP

Date: May 15, 2007



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CLAIMS APPENDIX

1. (Previously Presented) A method of cleaning a chamber of an electron beam treatment apparatus, the method comprising:

(a) generating an electron beam current though a cleaning gas to energize the cleaning gas in the chamber of the electron beam treatment apparatus;

(b) monitoring an electron beam current;

(c) adjusting a pressure of the cleaning gas to maintain the electron beam current at a substantially constant value; and

(d) stopping the flow of cleaning gas when the cleaning gas pressure becomes substantially constant for a predetermined length of time.

2-3. (Canceled)

4. (Original) The method of claim 1 wherein the cleaning gas comprises an oxygen-based gas.

5. (Original) The method of claim 4 wherein the oxygen-based gas comprises one or more of 0_2, ozone, NO, and H_20.

6. (Original) The method of claim 1 wherein the cleaning gas comprises a fluorine-based gas.

7. (Previously presented) The method of claim 6 wherein the fluorine-based gas comprises one or more of NF_3, F_2, CF_4, C_2F_6, C_3F_8 and SF_6.

8. (Previously Presented) A method of cleaning an electron beam treatment chamber, the method comprising:

(a) generating an electron beam current though a cleaning gas to energize the cleaning gas in the electron beam treatment chamber;

(b) adjusting a pressure of the cleaning gas to maintain the electron beam current at a substantially constant value; and

(c) stopping the flow of cleaning gas after the cleaning gas pressure becomes substantially constant for a predetermined length of time.

9. (Original) The method of claim 8 wherein the cleaning gas comprises an oxygen-based gas.

10. (Original) The method of claim 9 wherein the oxygen-based gas comprises one or more of 0_2, ozone, NO, and H_20.

11. (Original) The method of claim 8 wherein the cleaning gas comprises a fluorine-based gas.

12. (Previously presented) The method of claim 11 wherein the fluorine-based gas comprises one or more of NF_3, F_2, CF_4, C_2F_6, C_3F_8 and SF_6.

13. (Original) The method of claim 8 wherein a gas pressure of about 1 Torr or greater is maintained in the chamber.

14. (Original) The method of claim 9 wherein a gas pressure of about 1 Torr or greater is maintained in the chamber.

15. (Original) The method of claim 11 wherein a gas pressure of about 1 Torr or greater is maintained in the chamber.

16. (Previously Presented) A method of cleaning a chamber of an electron beam treatment apparatus, the method comprising:

(a) introducing a cleaning gas into the chamber;

(b) generating an electron beam current though the cleaning gas to energize the cleaning gas in the chamber;

(c) setting in the chamber, an electron beam current of about 1 mA or above;

(d) adjusting a pressure of the cleaning gas to maintain the electron beam current at a substantially constant value; and

(e) determining an endpoint of the cleaning process and stopping introduction of the cleaning gas when the cleaning gas pressure reaches a substantially constant value and maintains the value for a length of time of 5 seconds.

17. (Previously presented) The method of claim 16 wherein the cleaning gas comprises an oxygen-based gas.

18. (Previously presented) The method of claim 17 wherein the oxygen-based gas comprises one or more of O_2, ozone, NO, and H_2O.

19. (Previously presented) The method of claim 16 wherein the cleaning gas comprises a fluorine-based gas.

20. (Previously presented) The method of claim 19 wherein the fluorine-based gas comprises one or more of NF_3, F_2, CF_4, C_2F_6, C_3F_8 and, SF_6.

21. (Previously presented) The method of claim 1 comprising stopping the flow of cleaning gas when the cleaning gas pressure becomes substantially constant for a length of time of 5 seconds.

22. (Previously presented) The method of claim 8 comprising stopping the flow of cleaning gas when the cleaning gas pressure becomes substantially constant for a length of time of 5 seconds.

23. (Previously presented) The method of claim 16 comprising setting in the chamber, an electron beam current of about 10 mA or above.

EVIDENCE APPENDIX

None.

RELATED PROCEEDINGS APPENDIX

None.